

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark
Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year)

09 July 1998 (09.07.98)

International application No.

PCT/US96/19055

Applicant's or agent's file reference

DN1996221

International filing date (day/month/year)

27 November 1996 (27.11.96)

Priority date (day/month/year)

Applicant

SLIVKA, John, Joseph et al

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

18 June 1998 (18.06.98)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was



was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

A. Addae-Ruesch

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

REC'D 07 SEP 1998
WIPO PCT

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference DN1996221	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (PCT/IPEA/416)
International application No. PCT/US96/19055	International filing date (day/month/year) 27/11/1996	Priority date (day/month/year) 27/11/1996	
International Patent Classification (IPC) or national classification and IPC B60C9/26			
Applicant THE GOODYEAR TIRE & RUBBER COMPANY et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 18/06/1998	Date of completion of this report 29.98
Name and mailing address of the IPEA/  European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Eriksson, J Telephone No. (+49-89) 2399-8868 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/US96/19055

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

Description, pages:

1-6 as originally filed

Claims, No.:

1-11 as originally filed

Drawings, sheets:

1/1 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/US96/19055

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-11
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-11
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-11
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

SECTION V

Claim 1: Novelty YES

The subject matter of claim 1 is novel since no document discloses all the features of claim 1.

Claim 1: Inventive step YES

JP-A-07 009814 shows a high modulus belt reinforcement made of aramide cords which is wrapped around an outer belt with no folded edges.

FR-A-2 617 087 shows a belt reinforcement wrapped around an outer belt without folded edges.

LU-A-44 682 shows an aircraft tire comprising at least one pair of parallel annular beads, at least one carcass ply wrapped around said beads, a high modulus belt reinforcement with folded edges disposed over the carcass ply in the crown area of said tire, tread disposed over said belt reinforcement and sidewalls disposed between said tread and said beads.

Thus, the provision of the combination of features specified in claim 1 is clearly novel and in no way influenced by the prior art. The existence of an inventive step is obvious.

Claim 1: Industrial applicability YES

The industrial applicability is obvious.

Dependent claims 2 to 9

The subject matter of dependent claims 2 to 9 define preferred embodiments of the apparatus defined in claim 1 and obviously fulfil the requirements of novelty, inventive step and industrial applicability.

Claims 10 and 11

Claims 10 and 11 define a method of building a tire according to the invention and a method of building a belt package according to the invention. They are considered to fulfil the requirements of novelty, inventive step and industrial applicability.

SECTION VII

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

The terminology shall be consistent throughout the international application, Rule 10(2) PCT.

This is not the case with the layer of low modulus reinforcement material which is also called belt edge strip and belt edge strip ply.

Independent claim 1 is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art document LU-A-44 682, see section V, being placed in a preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

If, however, the applicant is of the opinion that the two-part form would be inappropriate, then reasons therefor should be provided in the letter of reply. In addition, the applicant should ensure that it is clear from the description which features of the subject-matter of claim 1 is known from document LU-A-44 682 (see the PCT Guidelines PCT/GL/3 III, 2.3a).

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document LU-A-44 682 is not mentioned in the description, nor is this document identified therein.

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

WHEELER, David E.
THE GOODYEAR TIRE & RUBBER COMPANY
Department 823
1144 East Market Street
Akron, Ohio 44316-0001
ETATS-UNIS D'AMERIQUE

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing
(day/month/year)

03 09. 98

Applicant's or agent's file reference
DN1996221

IMPORTANT NOTIFICATION

International application No.
PCT/US96/19055

International filing date (day/month/year)
27/11/1996

Priority date (day/month/year)
27/11/1996

Applicant

THE GOODYEAR TIRE & RUBBER COMPANY et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/

 European Patent Office
D-80298 Munich
Tel. (+49-89) 2399-0, Tx: 523656 epmu d
Fax: (+49-89) 2399-4465

Authorized officer

Moris, A

Tel. (+49-89) 2399-2973



73 KMS

TENT COOPERATION TREA

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference DN1996221	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">FOR FURTHER ACTION</div> <div>see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.</div> </div>	
International application No. PCT/US 96/ 19055	International filing date(<i>day/month/year</i>) 27/11/1996	(Earliest) Priority Date (<i>day/month/year</i>)
Applicant THE GOODYEAR TIRE & RUBBER COMPANY et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (see Box I).
2. ☐ Unity of invention is lacking (see Box II).
3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.
☐ furnished by the applicant separately from the international application,

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ Transcribed by this Authority
4. With regard to the **title**, ☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:
5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.
☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.
6. The figure of the drawings to be published with the abstract is:
 Figure No. 2

☐ as suggested by the applicant. ☐ None of the figures.
☐ because the applicant failed to suggest a figure.
☒ because this figure better characterizes the invention.

TENT COOPERATION TREATY

RECEIVED

NOV 3 1997

PCT GOODYEAR PATENT & TRADEMARK DEPT.

From the INTERNATIONAL SEARCHING AUTHORITY

To:

THE GOODYEAR TIRE & RUBBER COMPANY
Department 823
Attn. WHEELER, David E.
1144 East Market Street
Akron, Ohio 44316-0001
UNITED STATES OF AMERICA

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

RECEIVED

(PCT Rule 44.1)

SEP 12 1997

GOODYEAR PAT/TM SECTION

of mailing
(day/month/year)

05.09.97

Applicant's or agent's file reference

DN1996221

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.

PCT/US 96/19055

International filing date

(day/month/year)

27/11/1996

Applicant

THE GOODYEAR TIRE & RUBBER COMPANY et al.

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicants's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Alex Schmidt

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers: claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

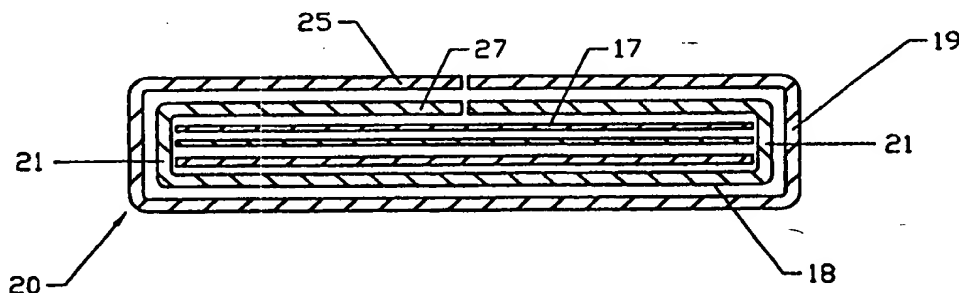
For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : B60C 9/26, 9/20, B29D 30/24	A1	(11) International Publication Number: WO 98/23456 (43) International Publication Date: 4 June 1998 (04.06.98)
(21) International Application Number: PCT/US96/19055 (22) International Filing Date: 27 November 1996 (27.11.96) (71) Applicant (for all designated States except US): THE GOODYEAR TIRE & RUBBER COMPANY [US/US]; 1144 East Market Street, Akron, OH 44316-0001 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): SLIVKA, John, Joseph [US/US]; 549 Oak Creek Drive, Danville, VA 24541 (US). COOPER, Thomas, William [US/US]; 601 South Prospect Avenue, Harville, OH 44632 (US). STILLEY, Hal, Warren, Jr. [US/US]; 802 Corn Tassel Road, Danville, VA 24540 (US). HASH, Oscar, Allen [US/US]; 1570 Olde Hunting Trail, Danville, VA 24540 (US). WARD, Jerome, Wesley [US/US]; 5452 Franklin Turnpike, Danville, VA 24540 (US). (74) Agent: WHEELER, David, E.; The Goodyear Tire & Rubber Company, Dept. 823, 1144 East Market Street, Akron, OH 44316-0001 (US).		(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, <u>DK</u> , ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>

(54) Title: AIRCRAFT TIRE WITH IMPROVED HIGH SPEED PROPERTIES

**(57) Abstract**

An aircraft tire having a folded belt construction and a belt edge strip over the folded belt construction has improved high speed properties. The belt edge strip substantially covers the top surface and/or the bottom surface of the folded belt in addition to the folded belt edges. The folded belt construction is reinforced with high modulus materials, and the belt edge strip is reinforced with low modulus materials. In a method of the invention, plies which make up the belt reinforcement package are applied to a belt building drum while the building drum is at different diameters to minimize stresses on the belt package. In a method of building a tire of the invention, a tire carcass on a tire building drum is expanded to the belt package.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav	TM	Turkmenistan
BF	Burkina Faso	GR	Greece		Republic of Macedonia	TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

AIRCRAFT TIRE WITH IMPROVED HIGH SPEED PROPERTIES

Technical Field

5 The invention relates to an aircraft tire with improved retreadability and improved high speed properties.

Background Art

10 In the prior art, nylon is a preferred reinforcement material for aircraft tires because it is forgiving and is not as subject to fatigue as other available materials. Nylon reinforcement, however, does not have superior strength and many plies of nylon are needed in the construction of an aircraft tire.

15 It is known in the art to build aircraft tires using aramid reinforcement, but such tires, although they can be constructed using fewer plies and have better wear than a nylon reinforced tire, are generally considered to be harder to qualify at high speeds and are not used in high speed applications.

20 Prior art tires have been constructed using a nylon reinforced carcass and a folded aramid belt reinforcement in the crown area of the tire. Such tires wear well, but they are generally accepted for use only at speeds up to about 190 mph, although applicant on several occasions has run successful tests on the tires up to about 210 mph. Such tires, however, show a high level of rejection for first retreading since folded edges of the folded belt show large numbers of separations when the tread is removed. Economical use of aircraft tires is highly dependant on the number of times an aircraft tire can be retreaded.

25 It is an object of the present invention to provide a tire construction which shows good wear and retreadability yet has improved high speed potential. Other objects of the invention will be apparent from the following specification and claims.

Summary of the Invention

30 An aircraft tire of the invention has at least one pair of parallel annular beads, at least one carcass ply wrapped around the beads, high modulus belt reinforcement disposed over the carcass ply in a crown area of the tire, tread disposed over the belt reinforcement, and sidewalls disposed between the tread and the beads, wherein the improvement comprises a layer of low modulus reinforcement material wrapped around the edges of the high modulus belt reinforcement. The high modulus belt reinforcement comprises high modulus reinforcement cords encapsulated in rubber to form a substantially two dimensional belt ply having length and width, and the layer of low modulus reinforcement comprises low modulus reinforcement cords
35 or filaments encapsulated in rubber to form a substantially two dimensional belt edge strip

having length and width. The belt structure in the illustrated embodiment is a belt ply folded into a folded belt structure wherein the belt ply has a width about twice the width of the folded belt structure. In one embodiment of the invention, the belt edge strip has substantially the same width as the belt ply and is folded completely around the folded belt structure. In another embodiment, the belt edge strip has a width about five-eighths to seven-eighths of the width of the belt ply and is placed radially inward of the folded belt, and the width edges of the belt edge strip are folded radially outward of the folded belt structure over the folded belt edges. In another alternative embodiment, the belt edge strip comprises split belt edge layers having a combined width of about five-eighths to seven-eighths of the width of the ply used to form the folded belt structure wherein one edge of each split layer is disposed radially inward of the belt ply and the distal end of each split layer is folded radially outward of the folded belt structure, substantially completely covering the radially outer surface of the folded belt structure.

In a specific illustrated embodiment of the invention, the high modulus reinforcement cords are aramid, the low modulus reinforcement cords are nylon and the high modulus reinforcement cords are disposed in a tire construction at an angle of ± 15 to $\pm 25^\circ$ with respect to the equatorial plane (EP) of the tire and the low modulus reinforcement cords are aligned in the same general direction as the high modulus reinforcement cords and are disposed at an angle of ± 15 to $\pm 29^\circ$ with respect to the EP of the tire.

Also provided is a method of building the tires of the invention, comprising the steps of reducing the diameter of a belt building drum below that required for assembly of a belt reinforcement package for a tire, applying a belt edge strip ply on the belt building drum, expanding the diameter of the belt building drum to a diameter which is still less than the diameter required for the tire, applying a belt ply over the belt edge strip ply on the belt building drum, expanding the diameter of the belt building drum to the diameter required for the belt of a tire, applying cut belts over the belt ply on the building drum, folding the belt ply and the belt edge strip ply over the cut belts, expanding a tire carcass to the belt package, and adding tread and sidewalls and any other external components required to complete the tire construction.

A method of building a belt package using the above steps is also provided.

Brief Description of Drawings

Fig. 1 illustrates a cross section of a tire of the invention.

Fig. 2 illustrates one embodiment of a belt of the tire encompassed by a low modulus reinforcement ply for reinforcing the crown area of the tire.

Fig. 3 illustrates an alternative reinforcement construction for the crown area of the tire.

Fig. 4 illustrates a second alternative construction for crown area reinforcement of the tire.

Detailed Description of the Invention

5 With reference to Fig. 1, in an illustrated embodiment, an aircraft tire 10 of the invention comprises a pair of parallel annular beads 12, carcass ply 13 wrapped around the beads, optional apex 22 above the bead and between the carcass ply and the carcass ply turnup, optional flipper 11 protecting the bead area, optional inner liner 14 radially inward of the carcass ply, reinforcement package 23 comprising folded belt 18 wrapped around cut belts 17
10 and low modulus reinforcement ply 19 wrapped around folded belt 18 disposed over carcass ply 13 in a crown area of the tire, tread 16 disposed radially above reinforcement package 23, and sidewalls 15 disposed between the tread and a bead area of the tire.

Those skilled in the art will recognize that aircraft tires are made with up to 4 pairs of beads and up to 12 carcass plies and up to 12 belt plies depending on their intended use.

15 Cut belts 17 and folded belt 18 comprise high modulus reinforcement cords embedded in rubber. Two to five cut belts can be used in the tire of the invention. In the illustrated embodiment, three cut belts having an end count of 14 to 22 e.p.i. are used. The ply used to form folded belt 18 also has an end count of 14 to 22 e.p.i.

20 The high modulus cords used in the invention may be, for example, aramid or steel, or any other high modulus material having similar properties, or a combination of such high modulus materials. Such reinforcement cords can comprise any suitable denier and any suitable twist. Such high modulus cords may be treated to increase their bond strength to rubber, and aramid reinforcement cords may be coated with an adhesive or an adhesive/epoxy combination. The high modulus cords used in the illustrated embodiment are 1500/3 denier aramid and have
25 a twist of 6.9/6.9.

Those skilled in the art will recognize that in a folded ply construction, cord reinforcement in the folded over part of the ply will have an equal but opposite angle with respect to the EP of the tire as the non folded over portion of the ply. As used herein, the angle of reinforcement cords in a folded ply will be indicated with a plus/minus (\pm) in front
30 of the angle. Angles of cords in other reinforcement plies in the tire will be given an absolute value, regardless of their general direction of orientation, it being understood that in most, but not all cut belt constructions, reinforcement cords in alternate cut belts are oriented in the opposite direction with respect to the EP of the tire. In the illustrated embodiment, the angle

of the reinforcement cords in the cut belts 17 are at an angle of 12 to 22° with respect to the EP of the tire and reinforcement cords in alternate cut belts have the opposite angle of orientation.

In the illustrated embodiment, aramid cords coated with an RFL adhesive and an end count of 20 e.p.i. were used, and the ply used to form folded belt 18 was incorporated into the tire wherein the reinforcement cords were oriented at an angle of $\pm 18^\circ$ with respect to the EP of the tire. In the illustrated embodiment, the tire is a radial ply tire wherein the reinforcement cords in the cut belt plies are oriented at an angle of 15° with respect to the EP of the tire.

Low modulus reinforcement ply 19 comprises low modulus reinforcement cords or filaments embedded in rubber and having an end count of 14 to 22 e.p.i.

Low modulus cords or filaments of, for example, nylon can be used in the construction of belt edge reinforcement 19. Such reinforcement cords can comprise any suitable size and twist, and in the illustrated embodiment, 840/2 denier nylon cords with a twist of 12/12 were used and incorporated in the ply at an end count of 21 e.p.i.

The angle of the low modulus reinforcement cords or filaments in the low modulus reinforcement ply 19 may be oriented in the tire having the same angle with respect to EP as the high modulus reinforcement cords in ply 18 up to an angle 4° greater than such high modulus cords and, accordingly, may be angled at ± 15 to $\pm 29^\circ$ with respect to the EP of the tire, and in the illustrated embodiment were oriented at the same angle as the reinforcement cords in folded belt 18.

Tires tested according to the invention were made using cable beads and a carcass construction comprising two turn-up plies and one turn-down ply. It is believed that the belt package reinforcement described will work with any conventional aircraft tire construction.

For the purposes of this invention, the belt ply and the belt edge strip plies are substantially two dimensional, those skilled in the art being aware that such plies are about 8 to 12 mm thick. For the tire in the illustrated embodiment, the full width of the ply used to form folded belt 18 is 9.8 inches and the width of the ply used to form belt edge strip 19 is 10.1 inches, and the length of both plies is about 74 inches, it being understood that the length and width can vary depending on the size of the tire and the tire construction in which the described belt reinforcement package is used.

The belt edge strip substantially covers the radially outermost surface and/or the radially innermost surface of the folded belt in addition to the folded belt edges.

In various illustrated embodiments, belt edge strip 19 may be applied to fully encompass folded belt 18 (Fig. 2), to be placed in the tire radially below ply 18 wherein the ply ends 25 are folded around the folded ends 21 of folded belt 18 (Fig. 3), or provided in split layers wherein the ends 42 of ply 19 radially below belt 18 cover the folded ends 21 of belt 18 and the distal ends 44 thereof are folded over ply 18 to fully encompass the radially outward portion thereof (Fig. 4). In general, the ply used to form belt edge strip 19 may have the same width or about five-eighths to seven-eighths of the width of the ply used to form folded belt 18.

In building the tires of the invention, it has been found that the various ply used to make reinforcement package 23 tend to tangle and bunch if their actual length is not adjusted to reflect their actual relationship in the tire. For example, since the belt edge ply is the radially innermost belt package ply in the tire, its actual diameter in a completed tire is slightly less than the diameter of the cut belt plies which are disposed radially above the belt edge strip ply, and if all the plies are the same length, the radially innermost ply bunches when the top layers are added or when the carcass is expanded to meet the belt package during the tire building procedure. Accordingly, the method of building the tires of the invention comprises the steps of, reducing the diameter of a belt building drum below that required for building a belt, applying a belt edge strip ply to the belt building drum, expanding the diameter of the belt building drum to a diameter which is still less than the diameter required for building a tire, applying a belt ply over the belt edge strip ply on the belt building drum, expanding the diameter of the belt building drum to the diameter required for building a belt package for a tire, applying cut belts over the belt ply on the building drum, folding the belt ply and the belt edge strip ply over the cut belts, expanding the tire carcass to the belt package, and adding tread and sidewalls and any other external components required to complete the tire construction.

The belt package described herein may be useful in other types of tires and also provided is a method of building a belt package, said method comprising the steps for building a belt package described above.

Conventional tire building equipment may be used to carry out the method of the invention without modification. The tire construction is completed as is otherwise known in the art.

For purposes of illustration, a belt edge strip ply may have a length of about 73.5 inches, a ply for a folded belt may have a length of about 74 inches, and the cut belts may have a length of about 74.5 inches.

The belt edge ply and the belt ply are folded at the same time in the tire building procedure, and when the belt edge ply and the belt ply are the same width, a construction where a folded high modulus belt is encapsulated by a belt edge strip is formed as illustrated in Fig. 2. When the belt edge strip ply is not as wide as the belt ply, a construction similar to that illustrated in Fig. 3 is obtained using the same technique. To form the construction illustrated in Fig. 4, two split layers of belt edge strip are applied to the building drum wherein a first end 42 of belt edge strip 19b and 19c are applied to the drum followed by application of the belt ply to the drum, and distal ends 44 of split ply 19b and 19c are folded at the same time as the belt ply to form folded belt 18 and a reinforcement package including belt edge strips 19b and 19c.

In the embodiment illustrated in Fig. 3, the ply used as the belt edge reinforcement 19a is about three-fourths as wide as the ply used to form belt 18. In Fig. 4, the combined width of belt edge plies 19b and 19c is about three-fourths of the width of the ply used to form belt 18.

As illustrated in Fig. 2, it is preferred that the folded ends 27 of the ply used to form folded belt 18 and ply ends 25 of belt edge reinforcement 19 be in abutment at the EP of the tire, but those skilled in the art will recognize that the ends 27 of the belt ply and ends 25 of the belt edge strip ply can be off-set from the EP of the tire, and in some applications, the belt ply ends 27 and belt edge strip ply ends 25 may be short of abutment or may form an overlap splice.

Aircraft tires of the kind illustrated herein are qualified by a step load test where tires at a specific load are run at various increasing speed steps up to a maximum, and under an increased load are run through the speed steps again. A tire qualifies if it finishes intact 61 cycles of this test at the designated loads and speeds.

Tires of the invention have been preliminarily qualified at speeds of 210 mph in a radial aircraft tire size 26x6.6R14 14PR, and it is believed that such tires will qualify at 225 mph. It is believed also that retreadability will be increased substantially. It has been shown that tires of the invention show increased tread wear as compared to similarly constructed tires using nylon belt reinforcement.

While the invention has been variously illustrated and described, those skilled in the art will recognize that the invention may be variously modified and practiced. The scope of the invention is limited only by the following claims.

CLAIMS

1. An aircraft tire comprising at least one pair of parallel annular beads, at least one carcass ply wrapped around said beads, folded high modulus belt reinforcement disposed over said carcass ply in a crown area of said tire, tread disposed over said belt reinforcement and sidewalls disposed between said tread and said beads, wherein the improvement comprises a layer of low modulus reinforcement material wrapped around the folded edges of said high modulus belt reinforcement.
2. The aircraft tire of claim 1 wherein said high modulus belt reinforcement comprises high modulus reinforcement cords encapsulated in rubber to form a substantially two dimensional belt ply having length and width, and said layer of low modulus reinforcement comprises low modulus reinforcement cords or filaments encapsulated in rubber to form a substantially two dimensional belt edge ply strip having length and width.
3. The aircraft tire of claim 2 wherein said high-modulus reinforcement is a belt ply folded into a folded belt structure wherein the belt ply has a width about twice the width of the folded belt structure.
4. The aircraft tire of claim 3 wherein said belt edge strip has substantially the same width as said belt ply and is folded completely around said folded belt structure.
5. The aircraft tire of claim 3 wherein said belt edge strip has a width about five-eighths to seven eighths of the width of said belt ply and is placed radially below said folded belt and the edges of said belt edge strip are folded radially above said folded belt structure.
6. The aircraft tire of claim 3 wherein said belt edge strip comprises split belt edge layers having a combined width of about five-eighths to seven eighths of the width of said belt ply wherein one edge of each split layer is disposed radially below said folded belt and the distal end of each split layer is folded radially above the folded belt structure substantially completely covering the radially outer surface of said folded belt structure.
7. The aircraft tire of claim 2 wherein said high modulus reinforcement cords are aramid.
8. The aircraft tire of claim 2 wherein said low modulus reinforcement cords are nylon.
9. The aircraft tire of claim 2 wherein said high modulus reinforcement cords are disposed in a tire construction at an angle of ± 15 to $\pm 25^\circ$ with respect to the equatorial plane (EP) of the tire and said low modulus reinforcement cords are aligned in the same general direction as said high modulus reinforcement cords and are disposed at an angle of ± 15 to $\pm 29^\circ$ with respect to the EP of the tire.

10. A method of building an aircraft tire comprising the steps of
- (a) reducing the diameter of a belt building drum below that required for building a belt package for a tire,
 - (b) applying a belt edge strip ply to said belt building drum,
 - 5 (c) expanding the diameter of said belt building drum to a diameter which is still less than the diameter required for building a belt package for a tire,
 - (d) applying a belt ply over said belt edge strip ply on said belt building drum,
 - (e) expanding the diameter of said belt building drum to the diameter required for building a belt package for a tire,
 - 10 (f) applying cut belts over said belt ply,
 - (g) folding the belt ply and the belt edge strip ply over said cut belts,
 - (h) expanding a tire carcass on a tire building drum to the belt package, and
 - (i) adding tread and sidewalls and any other external components required to complete the construction.
- 15 11. A method of building a belt package for a pneumatic tire comprising the sequential steps of
- (a) reducing the diameter of a belt building drum below that required for building a belt package for a tire,
 - (b) applying a belt edge strip ply to said belt building drum,
 - 20 (c) expanding the diameter of said belt building drum to a diameter which is still less than the diameter required for building a belt package for a tire,
 - (d) applying a belt ply over said belt edge strip ply on said belt building drum,
 - (e) expanding the diameter of said belt building drum to the diameter required for building a tire,
 - 25 (f) applying cut belts over said belt ply,
 - (g) folding the belt ply and the belt edge strip ply over said cut belts.

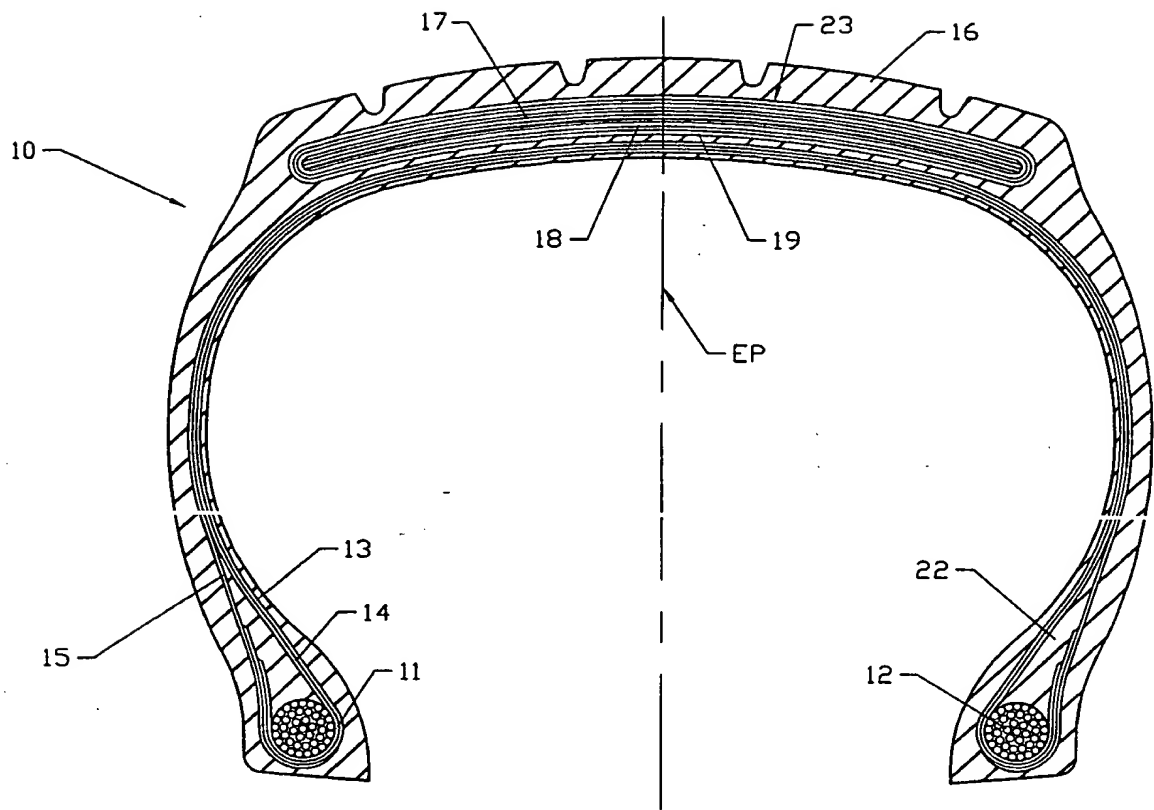


Fig.1

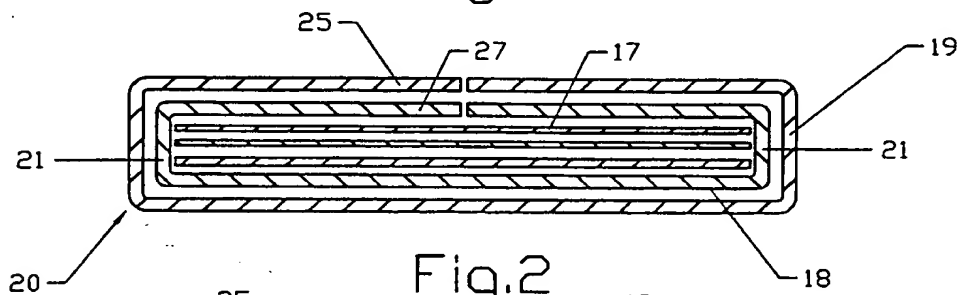


Fig.2

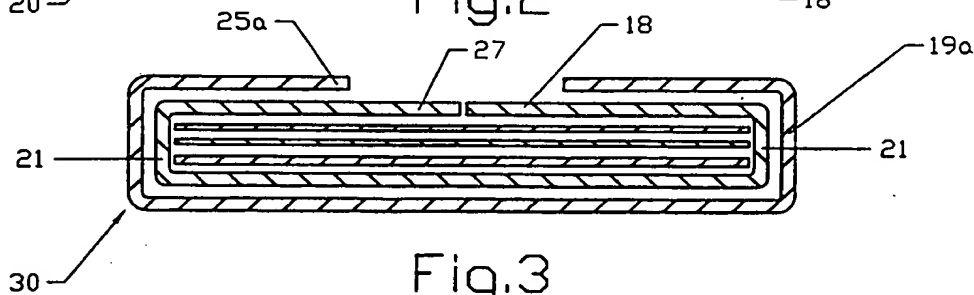


Fig.3

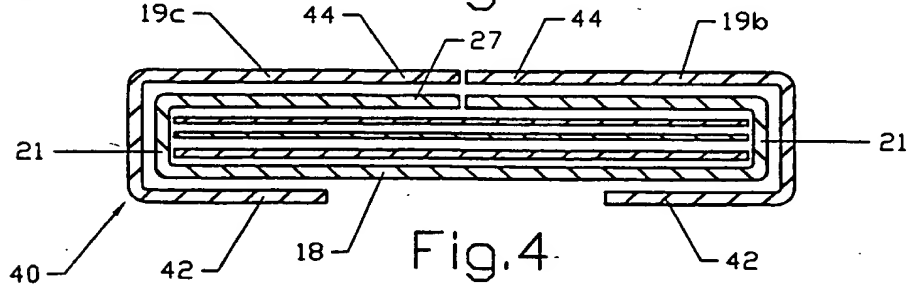


Fig.4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 96/19055

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B60C9/26 B60C9/20 B29D30/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B60C B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	PATENT ABSTRACTS OF JAPAN vol. 095, no. 004, 31 May 1995 & JP 07 009814 A (TOYO TIRE & RUBBER CO LTD), 13 January 1995, see abstract ---	1-3,7,8
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A	EP 0 479 065 A (GOODYEAR TIRE & RUBBER) 8 April 1992 see page 5, column 8, line 11 - line 22; claims; figures 4,5 ---	1,7,9-11
A	DE 19 43 842 A (METZELER AG.) 18 March 1971 see claims; figures ---	1
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

27 August 1997

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 96/19055

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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